DEFICIENCY OF VITAL POWER IN DISEASE,

AND

ON SUPPORT:

WITH

OBSERVATIONS UPON THE ACTION OF ALCOHOL IN SERIOUS CASES OF ACUTE DISEASE.

BY

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ON "DEFICIENCY OF VITAL POWER" IN DISEASE, AND ON "SUPPORT":

From the earliest ages, those who have devoted themselves to the study of disease have invariably attributed the highest importance to the condition of the blood. To a bad state of this fluid many ailments were attributed. To alter this state was the main object of the treatment to which the patient was subjected. Modern research has not failed to confirm the opinion so long and so generally entertained with reference to the high importance of a healthy state of blood; and modern practice is eminently conservative of this fluid. The very principles upon which the removal of large quantities of blood was advocated and carried out at various periods in the history of medicine have been overthrown, and the theories of inflammation which are even yet maintained by some, have been completely destroyed by observation and experiment. The blood, which used to be drawn for the purpose of reducing an excess of action, is now considered, in cases of the very same nature, to be absolutely necessary to the recovery of the patient; and it has been proved most conclusively—1. That morbid changes, which were supposed to be checked by bleeding, really continue in spite of it; and 2. That by violent bleeding the general condition of the patient is rendered much more serious. Formerly, a patient was bled to *cut short the disease;* now, he is bled only for

the purpose of relieving the tension of over-distended capillaries.

The blood has been, and still continues to be, regarded as a living fluid which carries life to all the tissues. Vital power is said to be reduced by abstraction of blood. Vital power is said to be restored or "renewed" by those remedies which increase the quantity of blood or improve its quality.

That the blood is the medium by which nutrient matter is distributed to all the tissues of the body, is beyond question. That its qualities are altered in disease, and that in many instances the blood is as it were the starting-point of certain morbid changes, is undoubtedly true. That remedial measures adopted with the view of altering the character and modifying the changes taking place in the blood in disease, are really efforts pursued in the right direction, seems to accord with the results of observation and experiment. But that the blood transmits *vital power* to the body generally, to the tissues of the body individually—that vital power is diminished by its abstraction, or increased by any alteration occurring in the blood—seems to me utterly untenable, and there is no reason whatever for assuming that what we call *vital power* can be carried from one place to another by any fluid or solid, and distributed to structures in a distant part of the body. Nor is it probable that this wonderful vital power can be added to or taken from any tissue at all. The blood may be called a *vital fluid*, but the term is not correct; for the soluble albuminous constituents, and probably even the red blood-corpuscles, are as inanimate while circulating in the vessels of the living body as they are after the blood has been withdrawn from the vessels.* And it would be as unreasonable to assert that the simplest vegetable and animal

* The matter of which each red blood-corpuscle is composed, tends to assume the crystalline form when its movement ceases. This is well seen in Guinea-pig's blood, where each red corpuscle becomes a tetrahedral crystal. This fact is conclusive against the notion that red blood-corpuscles are in an active state of vitality. Living matter does not crystallise.

organisms derive their nutriment from *living matter* in the medium that surrounds them, as to consider every fluid and every particle of matter which contributes to the nutrition of a living tissue in a state of active vitality.

On the contrary, every kind of pabulum is inanimate. Everything which contributes to nutrition is lifeless. Living matter never lives upon *living matter*. The pabulum of the tissues, especially in the case of man and the higher animals, results, no doubt, entirely from the death of living matter; but, as pabulum, it is inanimate. The blood, then, is not a living fluid. Although it contains masses of living matter (white corpuscles), it contains many corpuscles which are not living (fully formed red corpuscles). Neither is the fluid part of the blood living. Nor can blood, lymph, or chyle, or cod-liver oil, or alcohol, or any nutritive fluid whatever, be correctly spoken of as *life-giving*. And it is most important that I should express myself clearly upon this point; for undoubtedly many in their writings, perhaps unconsciously, exhibit a leaning towards the notion that certain lifeless organic or inorganic particles may come together under certain conditions, and afterwards exhibit *vital properties*, without any matter actually living being present. Now the evidence is most conclusive that particles of living matter exist smaller than any that we can see by the aid of the highest powers we possess—that is, three thousand diameters, or a power which would make one inch appear to occupy a length of 250 feet; and yet we have reason to believe that such minute particles have sprung from preëxisting living matter, because, when they grow large enough to be seen by us, they assume the parental characters; and, when one of the visible particles is divided into smaller portions, each portion grows and may extend itself, as from a centre, infinitely. Each separate particle increases, not by particles already existing being applied to it or coalescing with it, but by the passage of soluble matters into its very substance, and their conversion into matter of the same kind. I have brought forward many arguments

which seem to me to amount to proof that "*every living particle comes from a preexisting living particle*"; and I am convinced that it is as impossible for the smallest living particle to arise in these days in any other way than this, as it is for one of the higher forms of life to be produced spontaneously. Nothing gives life but that which is living; and it is as impossible for a living cell to spring up in a lifeless exudation, as it is for a living organism to arise in a chemical solution. Spontaneous generation in any form must be utterly abandoned, and we are now fully justified in condemning it absolutely. Neither even do certain conditions call forth "*vital energy*", or act as "*vital stimuli*", or increase vital power which already exists. Heat, various external conditions, and excitants or irritants, as they are termed, act simply by diminishing to some extent the restrictions under which life is ordinarily carried on.* Thus pabulum comes more readily and more quickly into contact with matter that already lives.

The blood does not transmit life to the tissues; for every tissue contains in its substance matter in a state of active vitality. The inanimate pabulum merely passes from the vessels and permeates the lifeless tissue. It comes into contact with the living matter; and certain of its constituents acquire at once vital properties, powers, or endowments. There is no reason to suppose that living matter (for instance, the so-called "nucleus" of a cell) exerts any influence upon matter at a distance from it; but it appears probable that in all cases the changes which occur in nutrition are simply these:—

1. The inanimate pabulum permeates the inanimate tissue (cell-wall, intercellular substance), and comes into contact with the living or germinal matter (usually termed "nucleus").

2. Certain of the inanimate constituents become living or germinal matter.

3. Particles of the living or germinal matter after a

* This question of stimuli, excitants, and irritants, is discussed in a short paper published in the *Lancet* for December 6th, 1862.

time undergo change—in fact die, and become gradually converted into inanimate "cell-contents", "cell-wall", or "intercellular substance".

4. These inanimate *formed substances* may accumulate and undergo condensation and other physical and chemical changes, or they may be resolved by the action of water, oxygen, and the like, into new substances as fast as they are produced. The substances produced, being carried off, constitute a secretion.

See diagrams illustrating these conclusions.

I have endeavoured to show that every tissue and every living organism is composed of elementary parts (cells); and that each of these consists of matter that is living and matter that was once alive—of germinal matter and formed material; and that vital changes go on in the first, while physical and chemical changes alone proceed in the last. For instance, of a cuticular cell, the so-called "nucleus" alone lives, while the hard cuticular matter upon which the properties of the cell depend is not alive; but this was *once* in the condition of the germinal matter.

I have also advanced many facts which justify this simple inference: that the rate at which this living matter grows, and is reproduced, is determined solely by the facility of access of the proper pabulum; so that, if nutrient matter comes into contact with the living matter readily, the living matter increases rapidly. In short, the more it is fed, the faster it grows. The *power* of growth of living matter remains the same, but growth always occurs under certain restrictions. The restrictions or impediments to the access of nutrient matter vary in different cells, and in the same cell at different periods of its existence.

Now we can tell at once, by the characters of a cell, whether it grows quickly or slowly. Wherever the outer part of the cell (formed material) is firm and hard, and not very permeable to nutrient matters, the growth must have been slow. Where the envelope is very thin, and where there is no envelope or cell-wall at all, the

greatest facilities for rapid growth exist. For example, contrast the pus-corpuscle, consisting almost entirely of germinal matter, with a fully formed cuticular cell, in which the germinal matter is surrounded by a very thick layer of slightly permeable cuticular substance. (See figures.) The restrictions to the growth of the last are far greater than the restrictions to the growth of the first.

Anything which renders the wall of such cuticular cell more permeable will facilitate the access of pabulum, and the germinal matter will increase more rapidly; so that rapidly-growing cells may come from slowly-growing cells. (See figures.) Pus may result from the rapid growth of the germinal matter of epithelium, fibrous tissue, nerve, or other tissue. Cancer grows faster than healthy epithelium or other normal tissue, but not so fast as pus; hence epithelial cancer is less permanent as a tissue than the normal epithelium, but more lasting than pus. In the normal state, the living matter of the cuticular cells, which gradually advance layer after layer towards the surface, dies very slowly and regularly; and the quantity of nutrient matter taken up becomes less and less as the cell advances in age. In epithelial cancer, the cuticular cells grow more quickly than the normal cells, because the outer part is softer and more permeable to nutrient pabulum.

In the formation of pus from cuticular epithelium, the pabulum comes into contact with the living matter; the corpuscles multiply, and at last so rapidly that there is not time for gradual conversion of the living or germinal matter into cuticular substance. The living cells, after accumulating for a time, escape from the surface, and are killed; or, the supply of nutrient matter ceasing, they die and become liquefied. If upon the surface the matter resulting forms a scab, beneath which the cells grow less rapidly, and time is allowed for the gradual formation of the external cell-wall or cuticular matter; if, in the substance of a tissue, the cells grow at the expense of the tissue, and increase in the cavity

or space thus formed (abscess), at last they will make their way through that part where resistance is the least; or, if deprived of pabulum, they may die, and the products resulting may be almost entirely absorbed, with the exception of a little fatty, saline, and insoluble albuminous matters, which remain, and form a thick matter of cheesy consistence, which undergoes very slow change. It will be said: "True; but pus and the cells of lymph and cancer are not *lasting structures*, and therefore do not evince the 'high state of vitality' characteristic of normal tissues." But, upon this view, *persistence*, *slow* growth, *slow* change, and the conversion of very *little nutrient matter* into living matter, are considered to be indications of a "high state of vitality". If we are to regard these characters, which exist in many healthy tissues, as evidence of an increased or high degree of vitality, as compared with pus, cancer, and other active and rapidly growing cells, then an old dry cell of cuticle is in a more vital state than a young and actively growing one; a dry hair is more vital than the soft cells of an intestinal villus; the hard dry cells of a cocoa-nut shell, or a walnut shell, or a peach stone, which have ceased to change, exhibit "vitality" in a more remarkable degree than the rapidly growing cells of a young leaf, than the rapidly multiplying cells of many fungi, and the soft moist cells of all growing and changing vegetable tissues. If this view be true, an old tissue is in a higher state of vitality than a young one. Still following out the same line of argument, we are forced to admit that that which has ceased to grow and has ceased to change —that which cannot form, or change, or modify—that which has no inherent power of motion, conversion, or formation—that which is, in short, *dead*—exhibits a higher degree of "vital activity" than the soft, ever-changing matter which possesses all these wonderful powers—which, in short, lives.

If, on the other hand, rapid growth—the appropriation of a large quantity of nutrient matter—rapid change —rapid increase of bulk—are evidences of a *high degree*

of vitality, then a pus-cell and a cancer-cell, so far from manifesting a deficiency of vital power, exhibit unmistakable evidence of vital activity, and agree in this with all young tissues, and with the rapidly growing "cells" of the adult organism. If "increased vital activity" means anything, it means that, in a given time, a greater quantity of inanimate pabulum becomes living matter; and it follows that pus and cancer and the granular cells, growing so fast in many morbid conditions, manifest *increased*, not *deficient vitality* as compared with epithelium. But it is more correc ıto say that, in the former, "the restrictions under which growth occurs are greatly diminished, as compared with the latter," than to speak of *varying degrees* or *excess* or *deficiency* of vital power.

In health, there are tissues exhibiting every degree of slow and rapid change (vital activity), from the scarcely altering enamel and dentine to the so-called cells (masses of germinal matter) which are found in such numbers in every villus, many of which pass through perhaps every phase of existeuce during the absorption of a single meal.

We very often find that tissues which grow very slowly in the normal state, in disease exhibit remarkably increased activity; and in this *more rapid growth* and change alone, does the morbid, oftentimes differ from the normal state.

It will he observed that, in these conclusions, I differ materially, and in fundamental principles, from the views generally eutertained. It is impossible, in a communication like the present, to advance all the arguments in favour of the inferences deduced; and to attempt this would be making this paper more tedious than it must of necessity be. But, unquestionably, good practice has been so frequently supported by thoroughly uusound reasoning, that it sometimes happeus that, when tho argument has been proved to be false, the practice is abandoued as useless; and thus from period to period we vacillate almost from one extreme to the

other, and from year to year we work in recurring circles. Earnest men become sceptics; and, in the course of years, most valuable practical conclusions, arrived at from actual experience, are forgotten, because the theory upon which these conclusions were based has been proved to be unsound. May we not retain in practice what in the depleting process has been proved to be true, although the principles upon which depletion was carried to extremes have been proved to be erroneous? Why may we not retain what is good in the system of support, although it may be true that stimulants neither support life, nor give life, nor nourish tissues, nor supply the place of food, nor directly affect the disintegration of tissues?

By violent bleeding, the blood that remains becomes weaker, and the watery parts necessarily permeate tissues more readily. Thus rapidly growing cells, such as exist in the air-cells in pneumonia, grow still faster, because they are supplied more freely with nutrient pabulum; while alcohol in several ways probably interferes with the growth of these cells, and thus tends to put a stop to the "inflammatory process". The results of practice support this theory: that in low conditions of the system, and by profuse bleedings, the growth of adventitious products is *accelerated;* while it is retarded by alcohol, acids, and some other substances.

Of all the dogmas ever insisted upon in the history of medicine, it is doubtful if any one has received more general support in one form or another, or has been adopted more generally, than the dogma that, in some way or other, disease is a *deficiency of action;* and that support is required to counteract this tendency to depression of the vital powers. Something extra must be added to make up for the loss occasioned by the diseased state. And, although we see structures in disease growing so fast that difference in bulk is perceptible from day to day, still we cry "*deficiency of action*", "*defective vital power*", "*diminished vitality*". The surgeon "*stimulates*" the wound with caustics, and "in-

creases" the "*vitality*" of the surface just below; the physician pours in brandy, and "*increases the vitality*" of the affected tissues; yet, after both applications, many cells that were alive are undoubtedly *killed*, and those that escape death live and *grow more slowly than before*. And this *diminished rate of growth and life* is just what is required—is the very condition which approaches to the healthy state. But is it not, as compared with the morbid state, the very reverse of "*increased vitality*"?

Now every one would argue that there was deficiency of vital power in a case of low pneumonia; and yet what evidence is there of such deficiency? It is true, the patient is weak and cannot move; he may be delirious; all his muscles may be relaxed; his heart's action may be weak; and he may be dying of exhaustion; but it has not been shown that weakness, or inability to move, or delirium, or relaxed muscles, or weak heart's action, or what we call "exhaustion", are due to depression of *vital power*. It is very well to say that in this particular morbid change there is "excess of action", and in that one there is deficiency, or in all disease there is deficiency of action; in this condition, "the vital powers are depressed, and we must give support"; and in another, "the vital powers are too active, and must be restrained;" —but these are, after all, merely dogmatic assertions, which have not been supported by observed facts.

We do not know what vital power is, although we are talking of it constantly as if it varied in quantity and intensity, and we were capable of adding to or taking from it. It is, therefore, much better to say that a patient is low or weak, than to say that he is suffering from a depressed state of the *vital powers*. The former asserts a fact; the latter enunciates a theory. We talk of excess of action, and diminished action, before we have agreed as to what we mean by the terms.

"Vital actions" and "physical actions" are, without doubt, constantly occurring in living bodies; and yet our knowledge of these two classes of actions is so very imperfect, that a very large number of philosophers in the

present day maintain that the changes occurring in living beings do uot differ in their essential nature from changes taking place in inorganic matter. But we, who are daily watching the changes occurring in the highest of living beings in health and in disease, feel quite convinced of the existence and activity of some power different in its essential nature from ordinary force. Life is not mere "direction" or "guidance"; nor will the view that the elements of matter arrange themselves in certain forms and compounds by accident, or according to the conditions uuder which they are placed, explain the phenomena. We feel compelled to acknowledge a peculiar power in living matter distinct from any forces in the inorganic world. Of this power we soe the results; and we are content to call it *vital power*, in contradistinction to the purely chemical and physical actions which also occur in living beings.

In cases of exhausting disease, we all talk very freely in these days of the importance of support; and many physicians would regard alcohol as the most valuable of all kinds of support given. Yet in these very cases the patient, in spite of all the sustenance, loses many pounds in weight in the course of a few weeks or even days; nor is it possible by any known means to prevent this result. And it is a fact that, in many of the worst cases I have seen, although the stomach seemed to do its work perfectly, and the quantities of "nutrient matter" and alcohol consumed by the patient were very great, the emaciation was extreme. The patient, under these circumstances, lives long enough to become extremely emaciated. Such emaciation would not exist if the patient were left to nature, because death would occur before matters had proceeded to this oxtremity. Now, in many of these cases, I feel confident that the stimulant is really the agent which has kept tho patient alive; for it sometimes happens that patients will not take any form of nutriment; and not unfrequently the stomach will bear whiskey or brandy, and in large quantity, where it instantly rejects beof-tea, milk, and othor

"nutritious substances". From what I have observed, I think it possible that a patient suffering from low pneumonia, or from a very severe form of continued fever, or acute rheumatism complicated with pericarditis and pneumonia, might be kept alive until the disease subsided by alcohol alone. The alcohol does not nourish the tissues; and it is very questionable if it diminishes the waste of the tissues in these cases, for in some the waste is indeed extreme. But the patient lives; and we account for the result by concluding at once that the alcohol must be a "*supporter of life*". But alcohol, administered in the very same quantities in the healthy state, might destroy life.

There is not a more important question in medicine than the action of alcohol in disease; for, while it has been conclusively proved that it is not a food and does not directly nourish the tissues, there cannot be the slightest difference of opinion among practical men as to its value as a remedy. We differ widely in our views as to the extent to which alcoholic treatment should be carried in a given case, but every one agrees as to its importance. This question of quantity will be considered in the sequel.

I propose now to discuss the mode of action of the alcohol in these cases of low disease. It seems to me impossible to ignore the chemical action of this substance. It is not possible to conceive that the large quantity of alcohol taken by many of the patients does not produce some change in the permeating properties of the fluid part of the blood, or some chemical alteration upon the soluble constituents belonging to the albuminous class, besides exerting a local influence upon soft and rapidly growing cells. It probably produces other changes besides these. Undoubtedly, in the normal state, alcohol affects the nervous system; but, in extreme cases of low disease, the nervous phenomena appear precisely as in health; and, in many cases, so little is the ordinary action of alcohol manifested, that a patient may be taking an ounce of brandy

every hour, and a bystander would not believe he was taking alcohol at all. That alcohol will produce delirium in health, and remove or prevent the occurrence of delirium in an exhausted state of the system, is perfectly true; but the fact is not to be fully explained in the present imperfect state of our knowledge of the action of nerve-centres and nerves.

Before I consider the action of alcohol when introduced into the blood through the stomach, it is important to refer to its action upon morbid changes taking place upon the surface of the body, and its influence upon the vessels of the part; for I feel sure that the mode of action is essentially the same in both cases.

If there be a little abrasion of the cuticle, around which the skin looks red and angry, the neighbouring tissue being hot, swollen, and painful, the capillaries so distended as to produce bright redness, it will be found that the occasional application of a drop of alcohol to the affected part will in the course of a single hour produce great changes. In and around such a spot, it is quite clear we have, not diminished, but increased action. Numerous small granular "cells" are multiplying rapidly in the deep layers of the cuticle. The "nuclei" of the nerves, capillaries, and connective tissue of the cutis, are larger than they were in the healthy state; the living matter is growing, dividing and subdividing into smaller portions, which will grow and again divide and subdivide. In the capillaries, and just external to them, are numerous white blood-corpuscles, varying in size from small points to the ordinary dimensions. These, like the living matter of the tissue, are rapidly increasing in number. The capillaries are gorged with blood, and their thin walls stretched to the utmost.

Now what happens when a drop of alcohol is applied to such a sore? Momentary pain, followed in the course of a few minutes by great relief, or complete cessation of pain, and diminished vascularity.

But how does the alcohol bring about such changes?

If alcohol be added to any serous fluid, the albumen is precipitated. If delicately granular cells are placed in alcohol, and afterwards examined under the microscope, every one knows that they will appear shrunken, and will have altered much in form; and they would resist disintegration by pressure to a greater extent than they did before. The surface of the wound is covered with a dry crust produced by the hardening effects of the alcohol; and some of the rapidly growing cells are quite destroyed, while others become surrounded with an envelope of hardened matter, which prevents the possibility of their absorbing nutriment and giving rise to new cells so rapidly as before. Not only so, but the permeating power of the nutrient fluid itself is diminished by the tendency of the alcohol to coagulate it. The most superficial of the cells, composed entirely of germinal matter, would be destroyed by alcohol, though not so quickly, perhaps, as by the actual cautery, nitrate of silver, sesquichloride of iron, sulphate of copper, etc.

Next comes a more difficult question: How does the alcohol cause the vessels of the inflamed part to contract, and permit the flow of less blood through them? If you press upon the distended vessels of an inflamed part, as is well known, the blood is driven out of them, and the skin becomes quite pale; but the moment the pressure is withdrawn, the redness recurs, and exhibits precisely the same tint as before. From this it is clear, not only that the capillaries are distended, but that the calibre of the small arteries through which the blood is distributed to them is much larger than in the normal condition. Besides this, the simple experiment proves that the vessels are maintained for a long time of a given calibre. Such a state of things can only result from the influence of nerves which govern the calibre of the small arteries; and thus the quantity of blood permitted to flow through them in a given time is regulated and varied from time to time. The mechanism is such that a small artery is made to assume a different calibre, although this may be momentarily altered by artificial

means. I have shown, contrary to the statement of Kölliker, that *all* the small arteries are abundantly supplied with nerves, and that nerves also ramify in the tissues external to the capillaries.

These are the *two* kinds of peripheral nerve-fibres which take part in regulating the supply of nutrient pabulum to every point of every tissue in the body.

1. The nerve-fibres distributed to the coats of small arteries and veins which ramify amongst the muscular fibres, and are *efferent* or *motor*.

2. The nerve-fibres distributed external to the capillaries, and in tissues which are altogether devoid of capillaries, are the *afferent* or *excitor* branches connected with the centres from which the vaso-motor nerves arise.* (See specimens of fibrous tissue, cornea, palate, and skin of frog.)

Now, any alteration taking place in the nutrition of the tissue-elements external to the capillaries must of necessity influence these excitor or afferent branches. The fibres may be subjected to increased or diminished pressure, to the influence of an increased or diminished quantity of fluid; and their numerous nuclei will necessarily be exposed to the same conditions as the nuclei of adjacent tissues. In the inflamed tissue, these "nuclei", like the nuclei of the tissues around, would receive more pabulum, would grow faster; and where growth and increase of living matter are most active, the particular action or function of the tissue is least manifested, because the function results from changes in matter which has been already *formed*. Hence it is not when nerves are *growing* that we find nervous action remarkably developed, but when they *have grown*. So here the nerves are less active than in the normal state, and we have dilatation of the vessels. A farther development of the same changes will lead to paralysis, and ultimately to complete destruction of the normal tissue.

* These branches have been demonstrated by me in many tissues, and form a new system of nerve-fibres, not previously described. (See *Archives*, No. XIII.)

Let me now consider what is the condition of things in pneumonia. The air-cells of the lung are filled with multitudes of living actively growing cells, which absorb a quantity of nutrient pabulum; and probably, as these cells increase in number, an increased proportion of pabulum is diverted from all parts of the body to the focus of inflammation. We *know* that a determination of common salt takes place to this spot; and it is only reasonable to infer that other matters are absorbed here, instead of being devoted to the ordinary changes occurring in the normal state. (*Med.-Chir. Trans.*, vol. xxxv, 1853.)

I have already spoken of the pabulum which in a fluid state transudes through the walls of the blood-vessels, and feeds the cells which lie just outside them. Not only are the capillaries more readily permeated by reason of the stretching and consequent thinning of their walls, but the fluid in the blood-vessels possesses a greater tendency to permeate animal membrane; so that it would seem but reasonable to consider if anything can be done to diminish this by altering the character of the fluid itself.

Many of the so-called tonics have the property of coagulating albuminous fluids and solutions of extractive matters. Preparations containing tannin, the mineral salts, such as the sulphate and sesquichloride of iron, nitric and hydrochloric acids, and a host of other remedies that will occur to every one, possess this property, and render solutions containing these and allied substances less permeable, perhaps by increasing their viscidity. The favourable action of such remedies is probably due to their direct influence on the fluid constituents of the blood. They, no doubt, also diminish the rate at which blood-corpuscles are disintegrated, and at the same time they tend to render the walls of the blood-vessels less permeable to fluids.

But, of all remedies, I believe alcohol acts most rapidly in this way, and in these particular cases most efficiently. The properties alcohol possesses of hard-

ening animal tissues, and of coagulating albuminous fluids, are well known; and these properties must not be forgotten when its effects in the animal body are discussed. Of course, when absorbed by the blood, it does not actually coagulate the albuminous matters; but it probably renders them less fluid, and reduces their permeating property. Alcohol interferes with the disintegration of blood-corpuscles; and in cases where this is going on very rapidly, and where fluid is passing through the walls of the vessels in considerable quantity, in consequence of the walls themselves being stretched and too readily permeable to fluids, alcohol is likely to be of service; but where these changes are occurriug very rapidly, and the patient's strength is fast ebbing, it may save life.

We may, therefore, explain the beneficial action of alcohol without assuming that it is a food, or contributes directly to the process of nutrition. Nay, though it merely filters through the blood-vessels, and leaves the body by different emunctories as fast as it is introduced, we can account reasonably for the good effects we observe.

It might be asked, upon the theory I have ventured to propound: How is it that the alcohol acts upon the morbid, and not upon the healthy structure? But the question has, in fact, been answered already. The healthy cells, being surrounded by a thick protective covering (cell-wall), are not affected by it; while the morbid cells, growing so fast that time is not allowed for the production of a hard external envelope, undergo the changes already described, and are caused to increase more slowly, while many are destroyed. So that, in the growing cells in the air-cells of a hepatised lung, there is *no deficiency* of *vital* power; and the remedies which act favourably really seem to act, not by *increasing vital power*, but by diminishing *the rate at which vital changes are proceeding*—in fact, by causing cells which were living *too fast* to live *more slowly*, and by producing *the death* of many.

This view of the action of alcohol accords with many broad facts familiar to all. It accounts for the shrivelling of the hepatic cells, the shrinking of the secreting structure, and the increased hardness and condensation of the entire liver, which result from the continual bathing of the gland-structure by blood loaded with alcohol. It accords with the gradual shrinking and condensation of tissues which occur in persons who have long been accustomed to excess. The tendency to increased formation of adipose tissue which occurs in persons who live generously, and seems to be augmented by alcohol, may be explained upon the same view, and the stunting in growth which follows its exhibition to young animals is readily accounted for.

It is most important, but in some cases very difficult, to determine the exact amount of stimulant that ought to be given; but even here we have very positive data for our guidance; and the general inference is, that a little more than the exact quantity absolutely necessary does no harm. I need scarcely say that in slight cases of fever, pneumonia, etc., no stimulant whatever is required; and that I am now discussing the action of alcohol in *very severe cases of disease* only.

1. In what appeared hopeless cases, as much brandy as the patient could be made to swallow (an ounce and a half to two ounces in an hour) has been given for several hours in succession, and then as much as thirty ounces a day for several days, not only without producing the slightest intoxication, vomiting, or headache, but the treatment has been followed by recovery.

2. I would adduce the fact that a man not accustomed to drink, when suffering from acute rheumatism, complicated with pericarditis with effusion, pneumonia at the base of one lung, and pleurisy on the opposite side, has taken twenty-four ounces of brandy a day for eleven days; the tongue being moist and the mind calm during the whole time. While under this treatment, inflammatory products were absorbed, and the general state of the patient much improved.

3. I have been compelled to give a very weak child, weighing less than four stone, twelve ounces of brandy a day for ten days, while suffering from acute rheumatism with pericarditis and effusion. This quantity did not produce the slightest tendency to intoxication, or exert other than a favourable effect upon the disease.

4. I would state that, among the general conclusions I have arrived at after carefully watching more than one hundred serious cases of acute disease treated with large quantities of stimulants, are the following:—*That intoxication is not produced,—that delirium, if it have occurred, ceases, or is prevented from occurring at all in the course of the case,—that headache is not occasioned, —that the action of the skin, kidneys, and bowels goes on freely,—that the tongue remains moist, or, if dry and often brown, often becomes moist,—that the pulse falls in frequency and increases in power,—that respiration is not impeded, but that, where even one entire lung is hepatised, the distress of breathing is not increased; and it appears that the respiratory changes go on under the disadvantageous circumstances present as well as if no alcohol were given.*

The conclusion from all this is, most certainly, that alcohol does not do harm in acute inflammation; that it does not produce intoxication in persons suffering from exhausting diseases; and that large quantities (from twelve to thirty ounces) may be given in cases which appear very unlikely to recover; and the conviction is forced upon the observer that, in desperate cases, these large quantities of alcohol are directly instrumental in saving life, not by *exciting or stimulating to increased action, but by moderating actions already excessive.*

In this communication I have adduced arguments in favour of the following propositions.

1. That each tissue contains *living matter*; and that this living matter is nourished by inanimate pabulum formed in the blood.

2. That, therefore, the blood neither *gives life* to the

tissues, nor *increases* nor *diminishes* the *vital powers* of the organism.

3. That remedies and foods of various kinds may modify, directly or indirectly, the composition of the pabulum distributed to the different tissues, or may influence the rate of growth of living matter; but neither foods nor remedies have powers of *giving* or *renewing* life.

4. *Tissue itself is not living*, and *cannot produce tissue* or *germinal matter ;* but germinal or living matter (1) converts inanimate pabulum into living matter like itself, and (2) becomes itself resolved into certain formed matters having definite characters and composition.

5. All living matter has the power of completely changing pabulum which comes into contact with it, and of communicating to certain constituents of this inanimate pabulum its own wonderful powers. The elements of the living matter which thus originates arrange themselves, or are arranged, in obedience to some peculiar force or power (vital); so that when at length they gradually cease to manifest these active (vital) powers, or die, definite substances result, the properties, form, and composition of which are totally different from the pabulum and from the living matter, although they contain the very same.

6. The rate of growth of living or germinal matter varies according to the freedom of access of the pabulum. The production of the peculiar kinds of formed material characteristic of the different tissues and different living beings requires *time*. It is generally a very slow process, and really *depends upon the gradual death of living particles under certain conditions.*

7. Rapid growth is always associated with a large proportion of germinal matter which is naked, or covered only by a very thin layer or envelope of thin permeable material. The production of firm impermeable formed material is always associated with slow growth.

8. If a tissue which, under normal circumstances,

grows slowly, and is characterised by the formation of firm, lasting formed material, like cuticle, cartilage, or tendon, grows very fast, it becomes represented by a soft spongy structure, which contains a much larger proportion of germinal matter than the normal tissue. Hence,

9. Many morbid processes are characterised, not by deficiency of action or defective vital power, but by the increased *activity of the vital changes*—that is, a greater quantity of inanimate pabulum becomes converted into living matter. Hence,

10. The object is, in many cases of disease, not to increase, but to diminish, the vital changes—to make the tissue live, *not faster*, but *more slowly*; and in some cases to destroy the life of the adventitious matter altogether.

11. In external wounds, and in internal diseases where alcohol acts beneficially, the good result is in part at least due to the alcohol checking the *increased action* already established.

12. Alcohol does not act as a food; it does not nourish tissues. It may diminish waste by altering the consistence and chemical properties of fluids and solids. It cuts short the life of rapidly growing cells, or causes them to live more slowly; and thus tends to cause a diseased texture, in which vital changes are abnormally active, to return *to its normal and much less active condition.*

13. Alcohol may possibly cause nerves to exhibit increased activity by restraining the abnormally free access of pabulum to their nuclei (germinal matter). The nervous, like other tissues, exhibits a greater activity of function when it has been *formed*, not while its germinal matter is growing fast and is freely supplied with pabulum.

14. In "exhausting" diseases, alcohol seems to act partly by diminishing very rapidly abnormally increased "cell-growth"; and the quantity required will depend upon the extent to which these changes have proceeded.

In extreme cases, half an ounce of brandy, or even more, may be given for a time (in some cases even for several days) every half hour; and there is reason to believe that, in desperate cases, life is sometimes saved by this treatment.

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